(12) UK Patent Application (19) GB (11) 2 244 799 (13) A

(43) Date of A publication 11.12.1991

(21) Application No 9012045.2

(22) Date of filing 30.05.1990

(71) Applicant
Welmark Limited

(Incorporated in the United Kingdom)

Unit 7, Mitchell Close, Segensworth East Industrial Estate, Fareham, Hampshire, PO15 5SE, United Kingdom

(72) Inventor
Jack Donald Wells

(74) Agent and/or Address for Service
Marks & Clerk
57-60 Lincoln's Inn Fields, London, WC2A 3LS, United Kingdom

(51) INT CL[5]
F24H 1/44, F23D 14/02

(52) UK CL (Edition K)
F4A AKE A302 A303 A304
F4T TGDX

(56) Documents cited
GB 2183016 A **GB 2115122 A** **GB 2060946 A**
GB 2060146 A **GB 1347104 A** **GB 1149162 A**
GB 1054858 A

(58) Field of search
UK CL (Edition K) **F4A AHB AKC AKE AKF AKM AP**
INT CL[5] **F24H 1/00**

(54) Boiler unit

(57) In order to provide a boiler unit which is simple to make in a variety of sizes, and which is economical of space in single or multiple boiler assemblies, and which can be adapted to include a condensing water heater, the boiler unit comprises a combustion chamber 6, with heat exchange conduits 2 for conducting the liquid to be heated, and headers at the opposite ends of the conduits defining all but one side of the combustion chamber, the burner unit 5 forming substantially the whole of the remaining side.

Fuel and air are mixed upstream of a burner plate by introducing fuel through radial openings in one or more fuel pipes into a stream of air which has just passed through orifices corresponding to the number of fuel pipes.

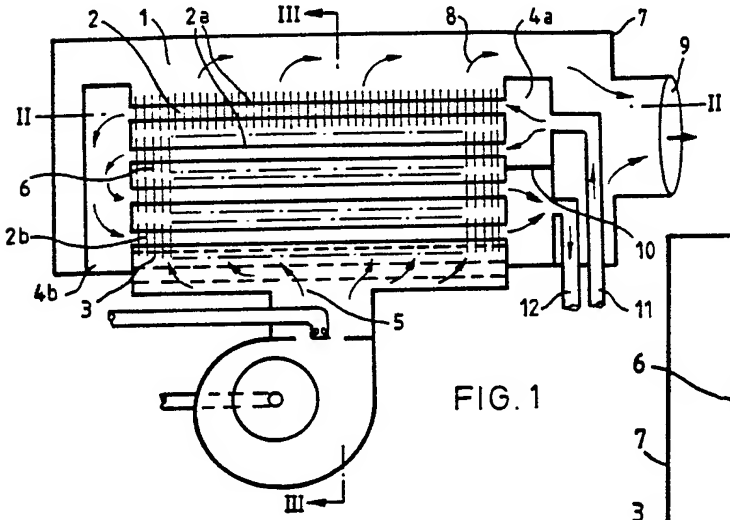

FIG. 1

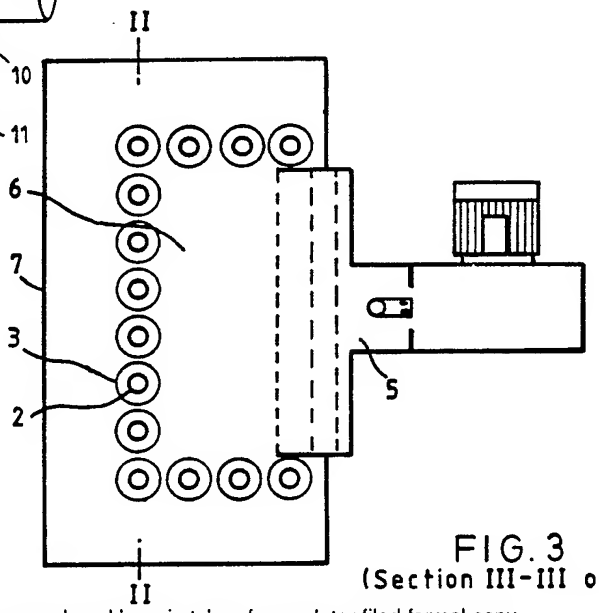

FIG. 3
(Section III-III of FIG.1)

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

GB 2 244 799 A

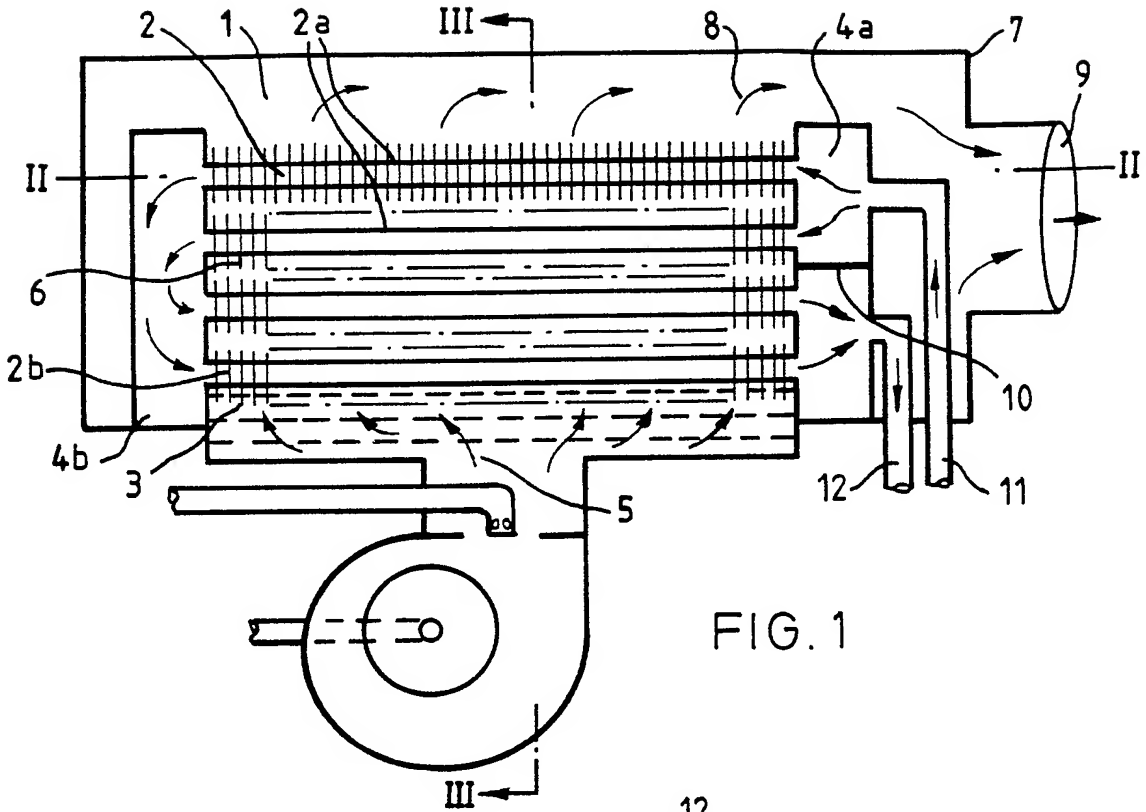
2
1
2a
III
8
4a
7
9
II
II
6
2b
10
4b
3
5
12
11
III

FIG. 1

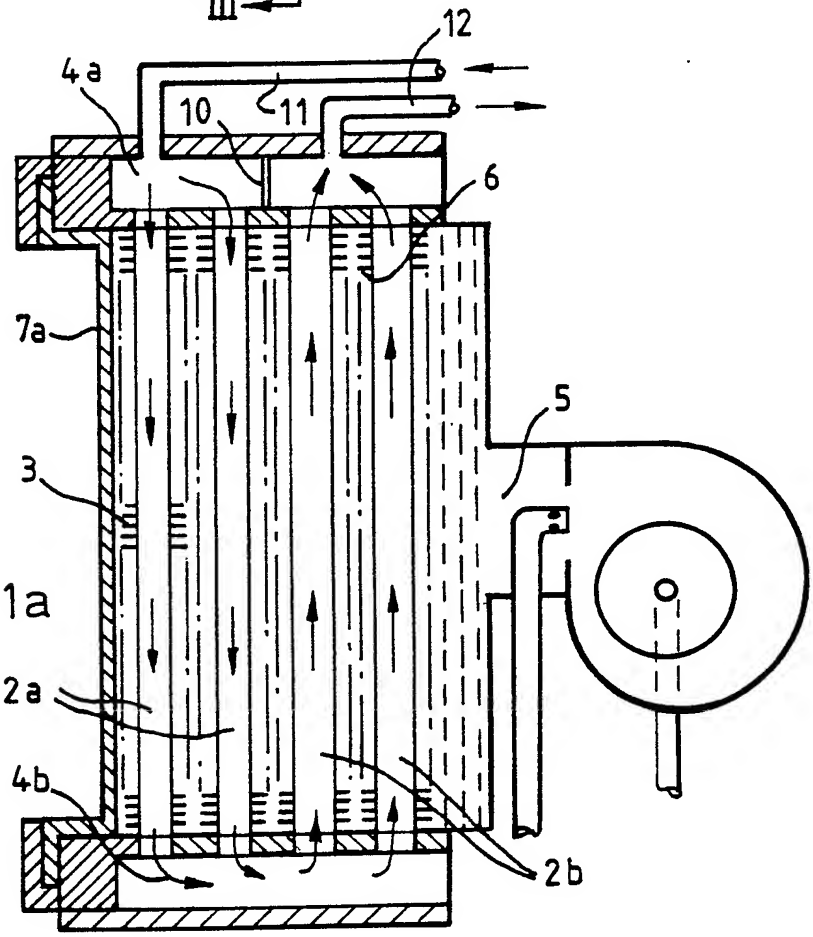
12
4a
10
11
6
7a
5
3
2a
4b
2b

FIG. 1a

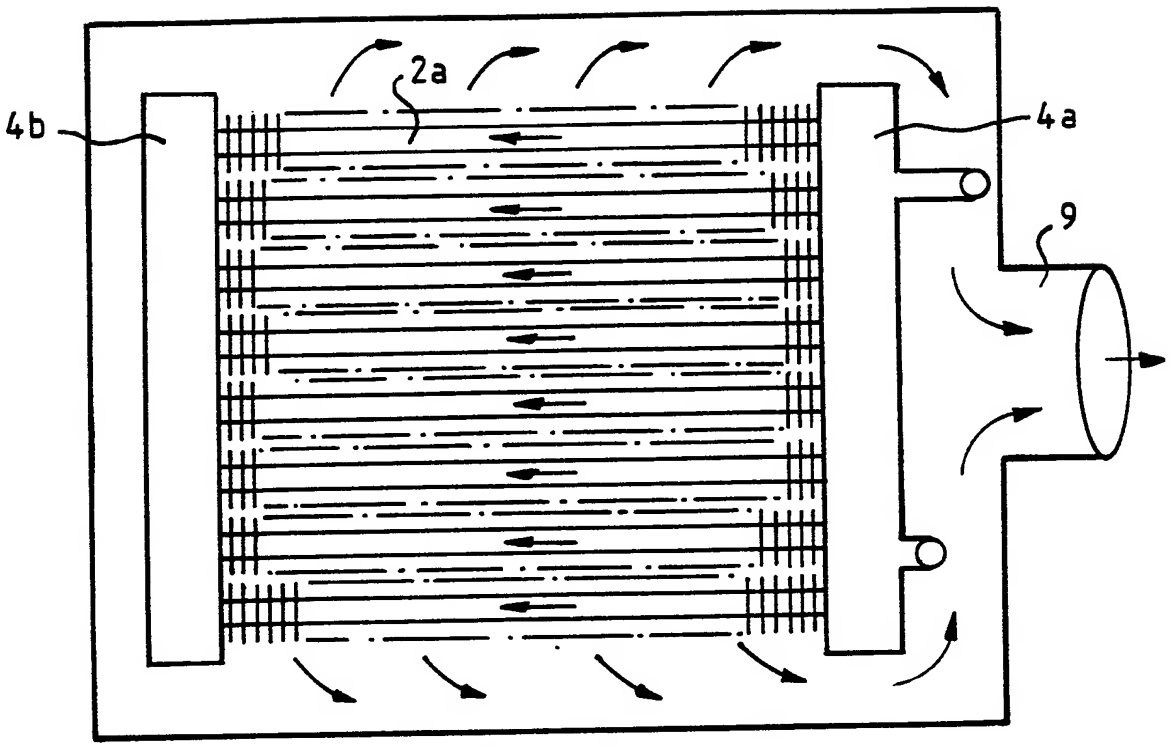

FIG. 2
(Section II-II of FIG.1)

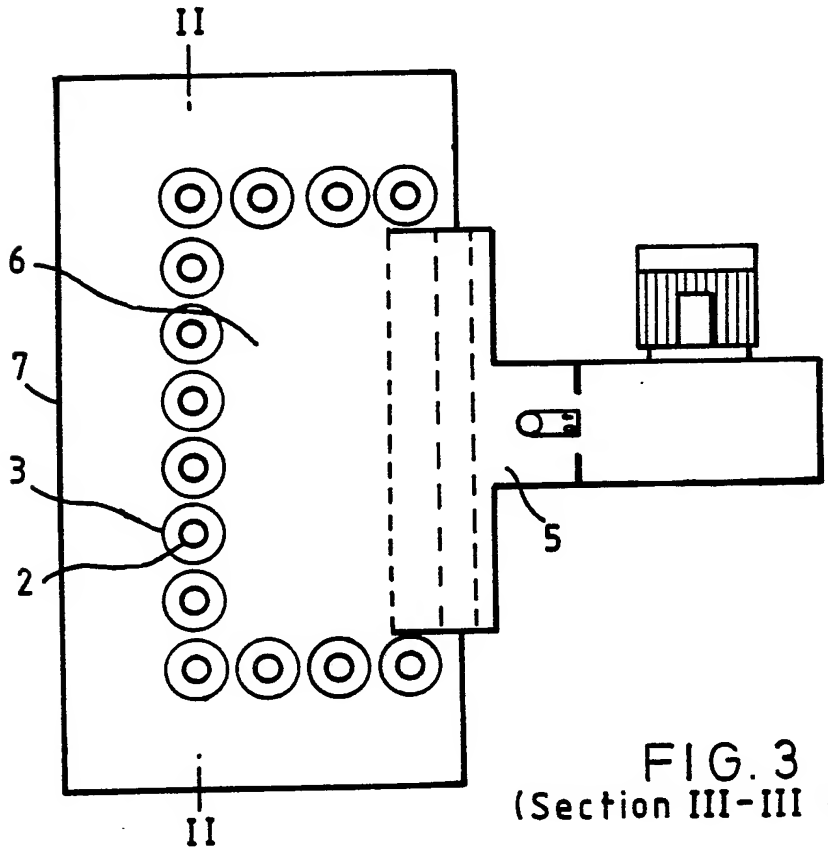

FIG. 3
(Section III-III of FIG.1)

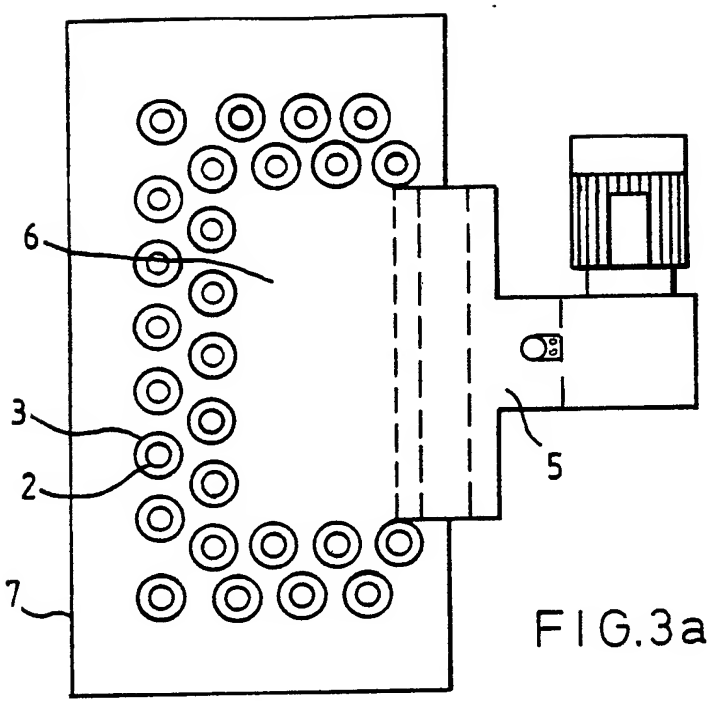

FIG.3a

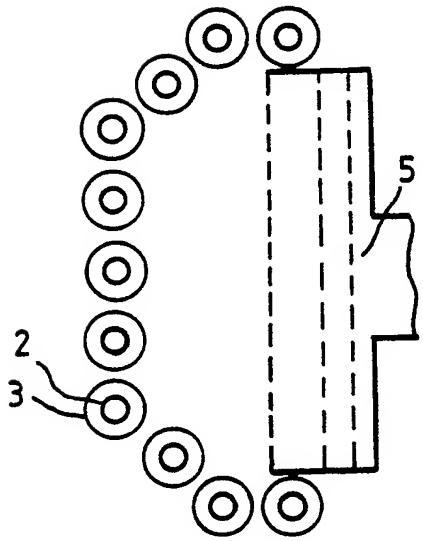

FIG.4

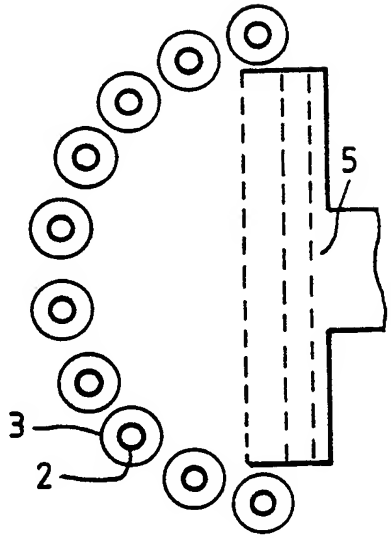

FIG.5

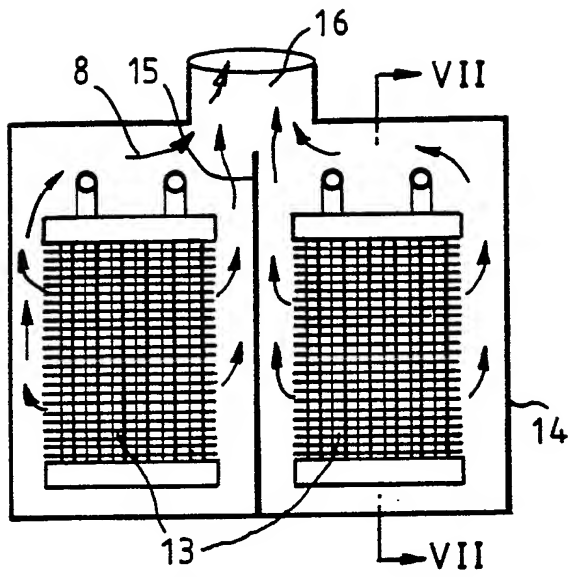

FIG.6

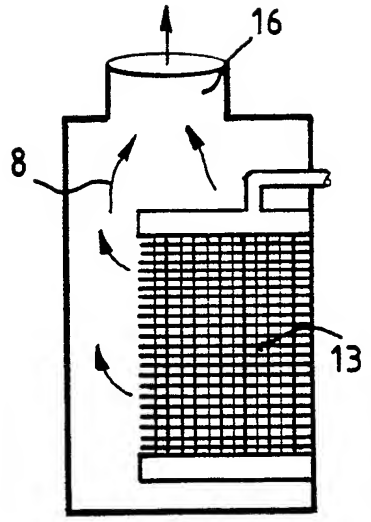

FIG.7
(Section VII-VII of FIG.6)

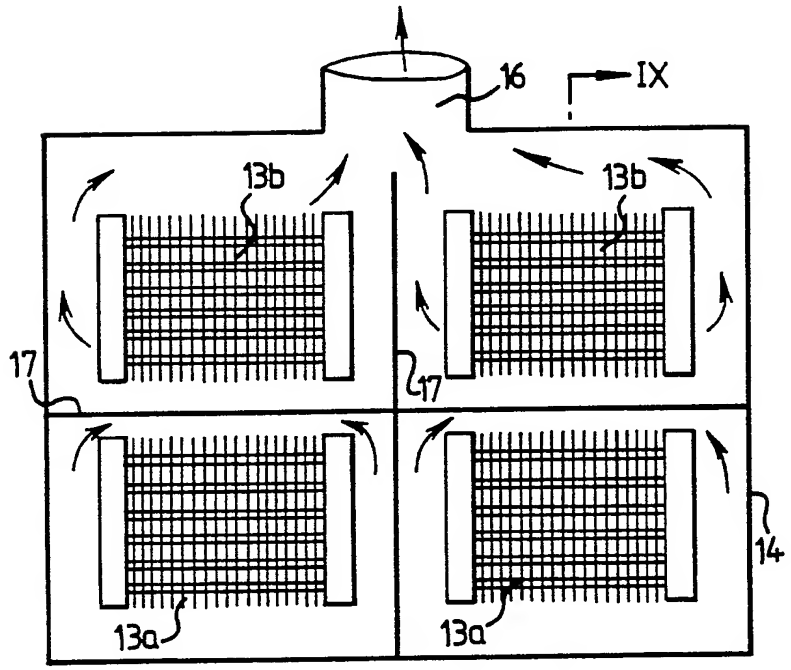

FIG.8

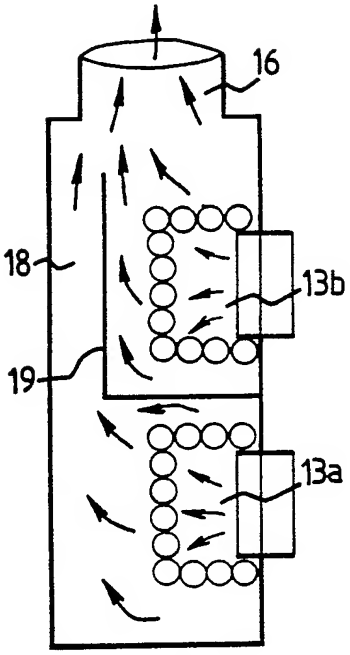

FIG.9
(Section IX-IX of FIG.8)

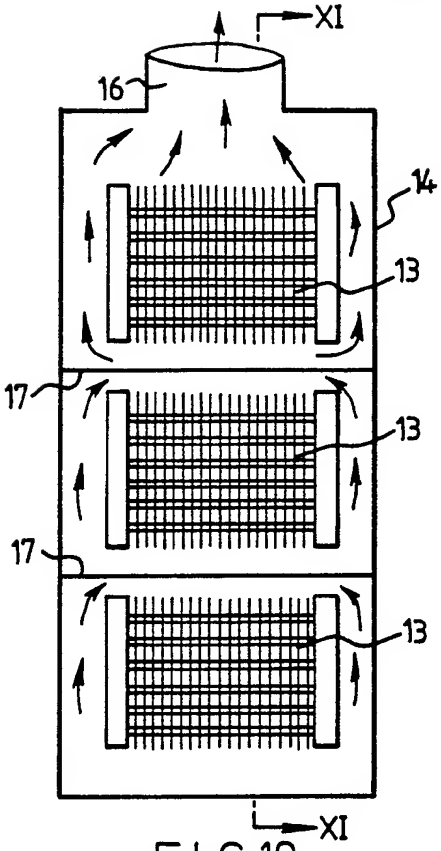

FIG.10

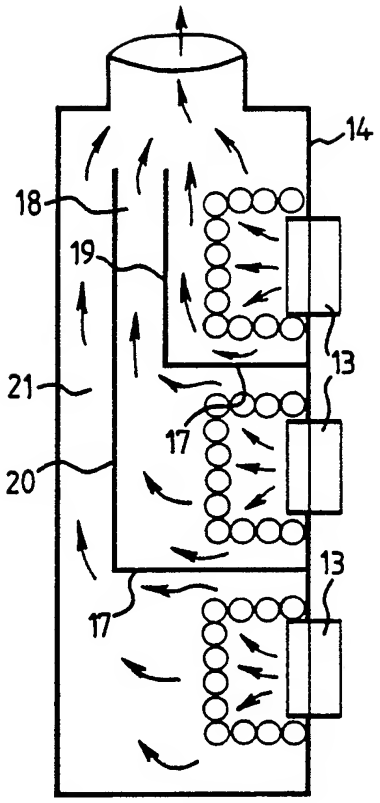

FIG.11
(Section XI-XI of FIG.10)

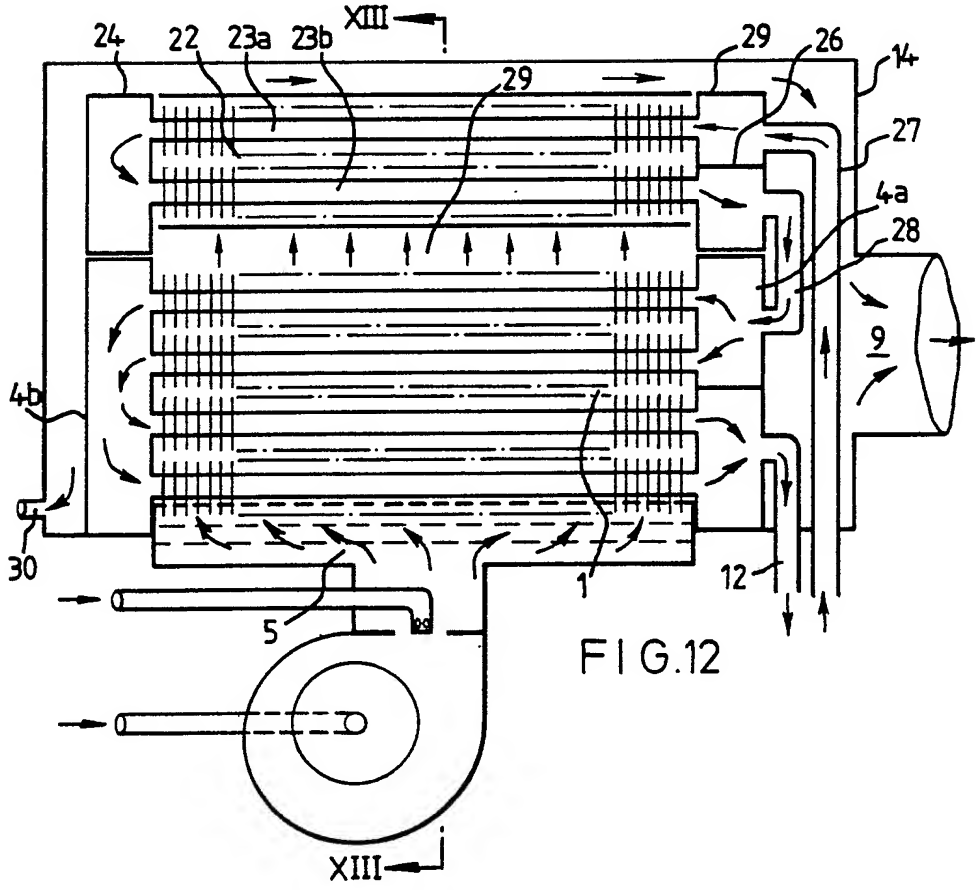

FIG.12

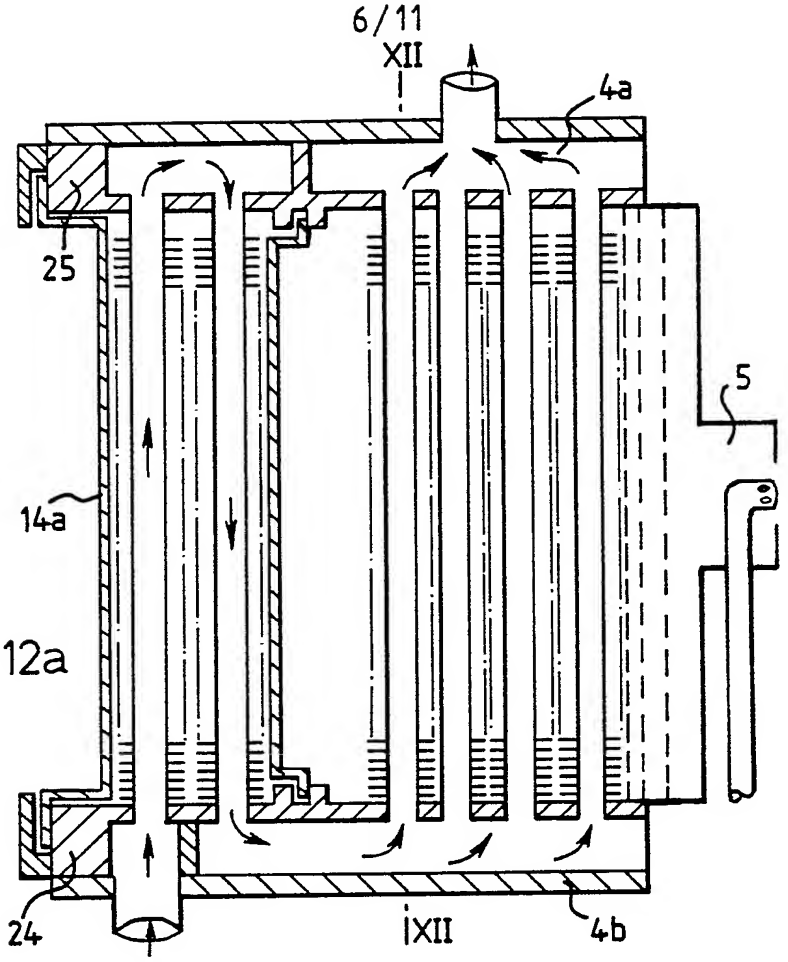

FIG.12a

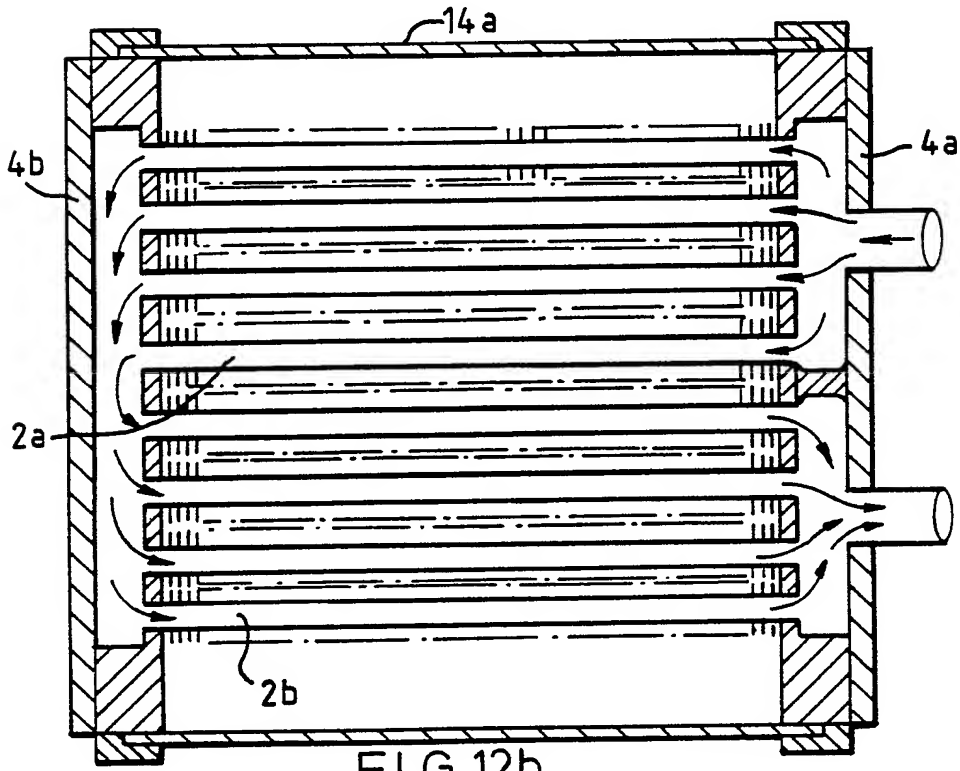

FIG.12b
(Section XII-XII of FIG.12a)

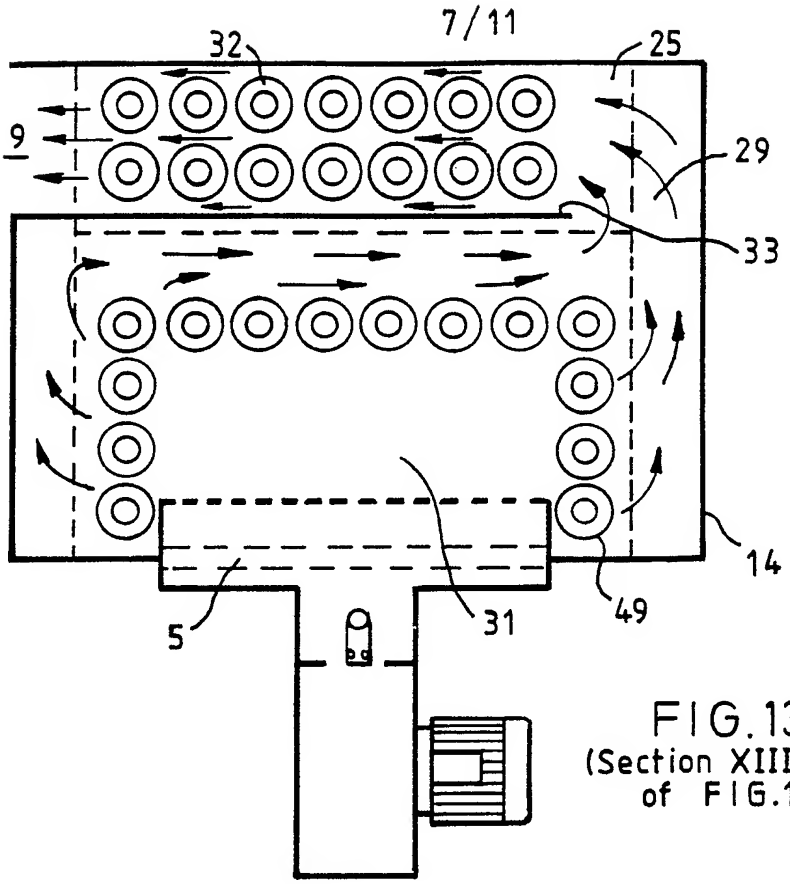

FIG.13
(Section XIII-XIII
of FIG.12)

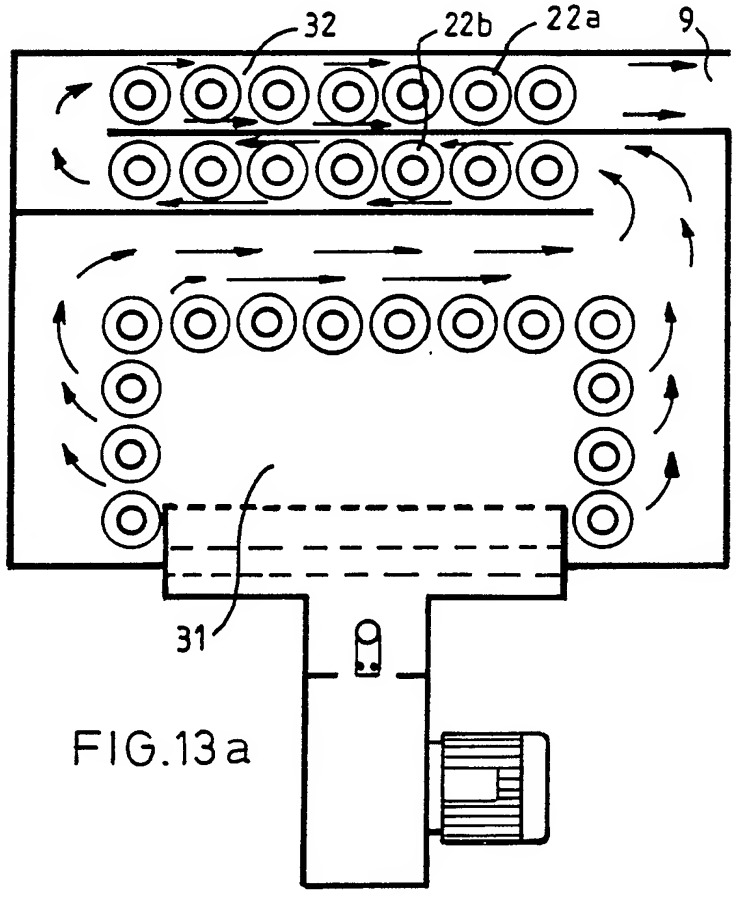

FIG.13a

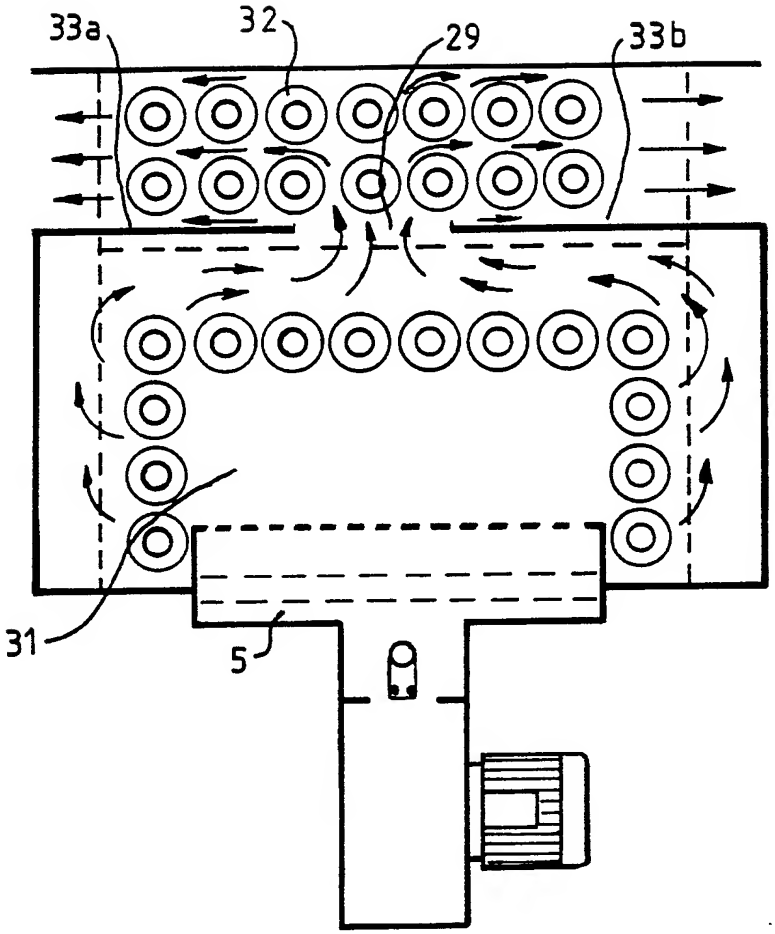

FIG.14
(Section XIII – XIII of FIG.12)

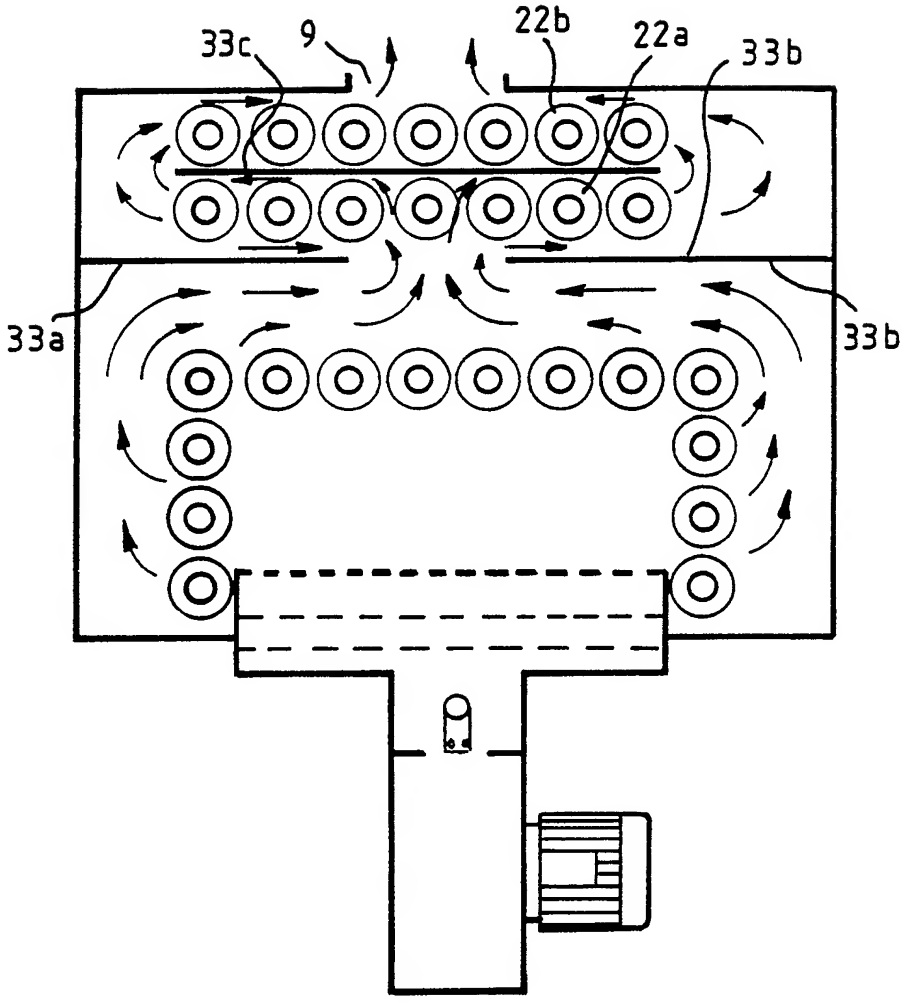

FIG. 14a

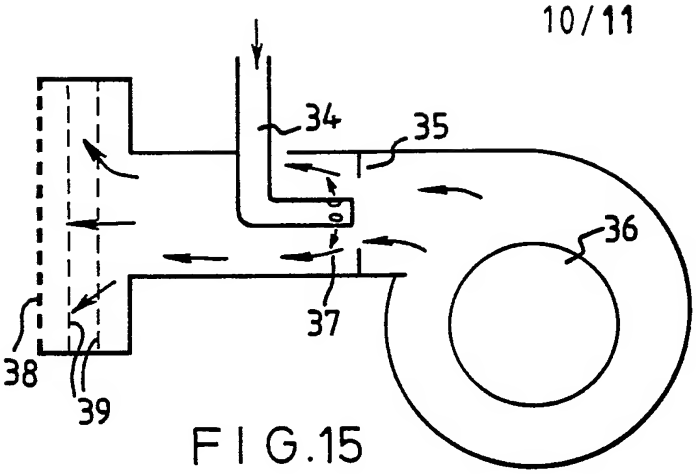

FIG.15

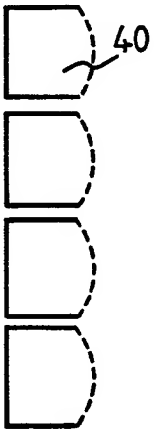

FIG.17

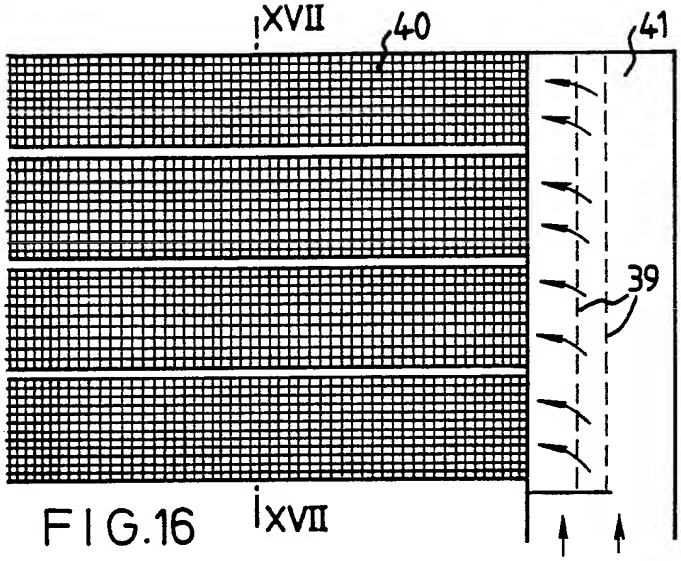

FIG.16

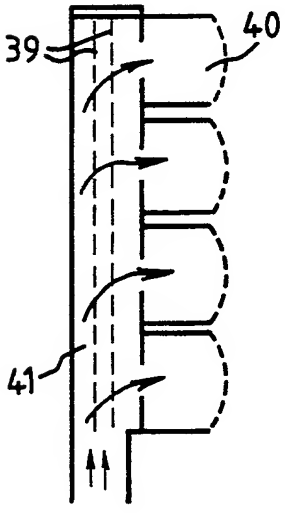

FIG.19

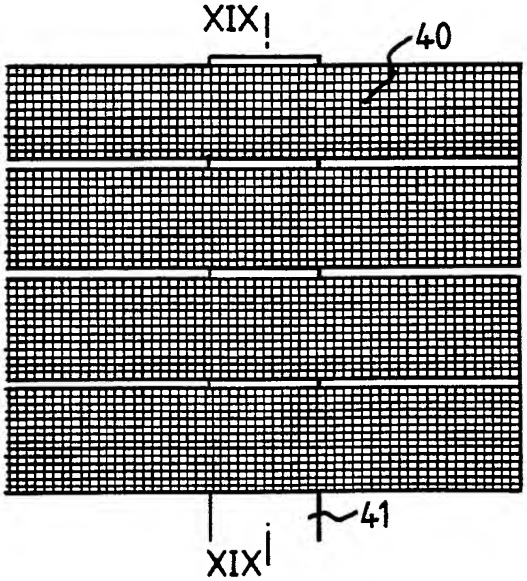

FIG.18

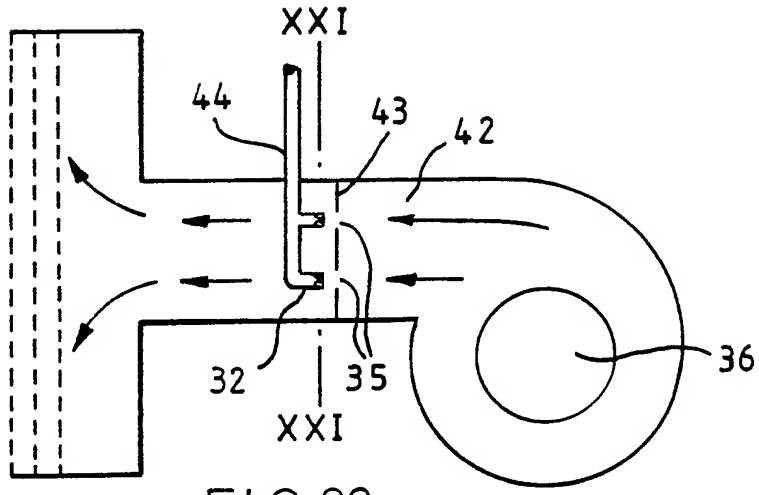

FIG.20

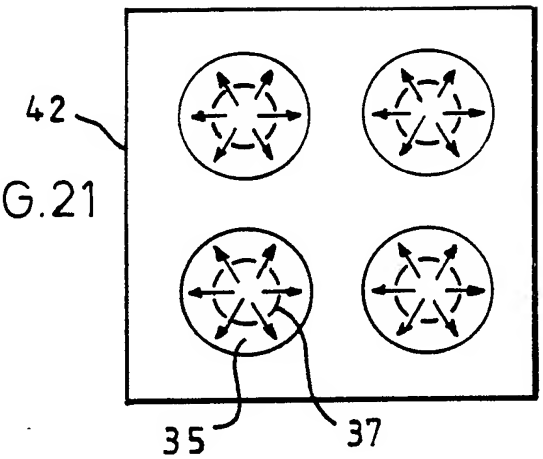

FIG.21

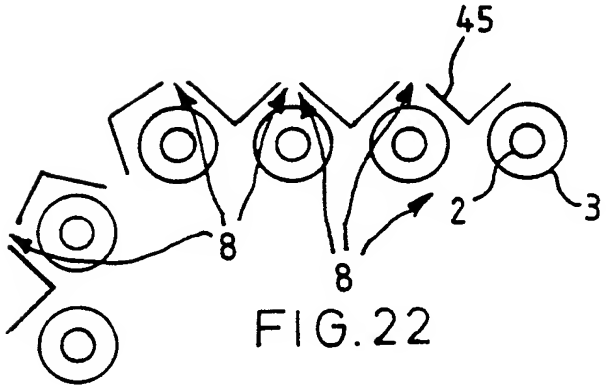

FIG.22

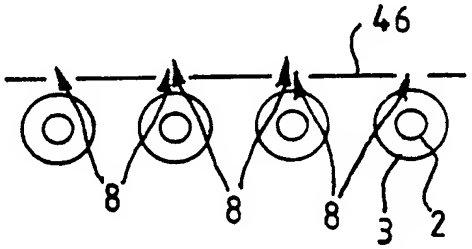

FIG.24

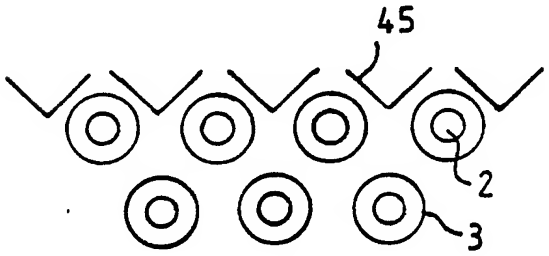

FIG.23

BOILER UNIT

Background of the Invention

The invention relates to a boiler, in particular a central heating boiler for use with gas or oil fuel. The invention also relates to boilers comprising condensing sections and to multiple arrangements of boiler units in a single casing.

GB 1 578 663 describes a central heating boiler comprising an array of parallel tubes (finned to increase effective heating surface) connecting two parallel opposing headers, the tubes and headers completely defining and enclosing a combustion zone. Water is fed into one header and out of the other, passing through the tubes wherein it is heated. Each header may be internally divided so that the liquid makes several passes through the combustion zone. A gas or oil fuel burner is located within the combustion zone, the combustion zone and the burner having substantially annular symmetry. This form of central heating boiler has the disadvantages that it is not very compact, and it proves difficult to scale up. Because of

the design of the burner, larger scale boilers tend to be long and thin, which is not a very efficient shape.

GB 2 115 122A discloses a central heating boiler in which a housing is provided, divided into sections by vertically extending plates. At one end there is a combustion chamber with a burner unit projecting into it, horizontally extending heat exchanger tubes (which in this case are not ribbed) are provided, most of which lie in the path of combustion gases, which flow from the combustion chamber to the flue via a labyrinthine passage defined by the vertically extending plates. More horizontally extending heat exchanger tubes are provided downstream of the combustion chamber to increase the efficiency of the boiler.

GB 1 556 813 sets out a central heating system which is designed to cope with large fluctuations in demand by having a number of individual boiler units which can operate in parallel and be successively cut in or cut out as the demand rises or drops. It is desired that the boiler units to be used in such a system should stack very compactly inside a single casing, to reduce the amount of space occupied by the system.

In order to improve the efficiency of central heating boilers, systems having secondary heat exchangers to

provide economisers, waste heat boilers or condensing water heaters have been developed. In these systems, the central heating boiler is provided with a further heat exchanger or series of further heat exchangers comprising parallel finned tubes connecting headers as in the main boiler, and lying in the path of the combustion gases leaving the main boiler. Water is circulated through this heat exchanger before being fed to the main boiler, so that it is pre-heated. In the case of condensing water heaters, the combustion gases are cooled so that any water vapour produced by combustion condensed, allowing the latent heat of evaporation of the water vapour to be recovered.

Accordingly, a condensate drain has to be provided. Boiler units as described in GB 1 578 663 have the disadvantage that they are not a convenient shape for adding secondary heat exchangers to.

It is desirable to provide a central heating boiler design which is simple to make and can be made in a large variety of sizes and which is also of a convenient shape for stacking with other boiler units in a single casing in a multiple boiler system and for adding secondary heat exchanger to. In particular, it is desirable to provide a design of a central heating boiler of substantially rectangular shape.

The Invention

A first aspect of the invention provides a boiler unit according to Claim 1, Claim 24 or Claim 26, preferred or optional features of the boiler unit are given in Claims 2 to 8. The invention also provides a boiler assembly according to Claim 9 or Claim 27.

The second aspect of the invention provides a fuel gas/air mixing device for a gas fired burner unit as set forth in Claims 17 and 28.

In general, the invention provides boiler units in which all sides except one substantially planar side of the combustion chamber are defined by elements of the heat exchanger, the heat exchanger comprising tubes and headers. This side is closed by the burner unit. This arrangement can be simple to construct, economical of space, easy to scale up and easy to adapt, e.g. by stacking several units in one casing or by adding a condensing water heater.

The headers of the heat exchanger may define sides of the combustion chamber adjacent the burner face. Preferably, the headers define sides of the combustion chamber opposing each other.

The boiler is designed so that the combustion gases flow from the burner past all the tubes of the heat exchanger and into a space defined between the tubes of the heat exchanger and an outer casing. The combustion gases then flow to the flue. This casing may completely envelope the heat exchanger, or alternatively, outer walls of the headers of the heat exchangers may define outside surfaces of the boiler unit, the casing comprising a wrapper plate extending between the two headers and engaging them in slide fit joints or expansion joints.

The burner unit of the second aspect of the invention is designed to give lower air pressure loss in the gas distribution part of the burner and sufficient mixing of the air and gas achieved in a shorter distance along the duct of the burner. More efficient mixing is achieved by using a large number of air orifices and gas distribution means than a single orifice and gas distribution means.

The invention will be further described, by way of example, with reference to the accompanying drawings in which:

Brief Description of the Drawings

Figure 1 shows a vertical cross-section of the boiler

according to the invention;

Figure 1a shows a vertical cross-section of another embodiment of a boiler according to the invention, in which the outer casing is formed from a wrapper-plate;

Figure 2 shows a vertical cross-section of the boiler of Figure 1, along line II-II as shown in Figure 1;

Figure 3 shows a horizontal cross-section of the boiler of Figure 1, along the line III-III as shown in Figure 1;

Figure 3a shows a horizontal cross-section of a different embodiment of the boiler of the invention, in which a double row of heat exchanger tubes is used;

Figure 4 shows a horizontal cross-section of the boiler according to another embodiment of the invention, on the same line as Figure 3;

Figure 5 shows a horizontal cross-section of the boiler according to another embodiment of the invention, along the same line as Figure 3;

Figures 6, 8 and 10 show three different embodiments of boiler assemblies comprising a number of boiler units according to the previous Figures assembled in a common

casing with a single flue;

Figures 7, 9 and 11 show vertical cross sections of the boilers as shown in Figures 6, 8 and 10 respectively, on lines VII-VII, IX-IX and XI-XI of Figures 6, 8 and 10 respectively;

Figure 12 shows a vertical cross-section of a boiler according to the invention having a secondary heat exchanger section;

Figure 12a shows a vertical cross-section of a boiler according to the invention having a secondary heat exchanger section, and in which the outer casing is defined by a wrapper plate;

Figure 12b shows a vertical cross-section of the boiler in Figure 12a along the line XII-XII;

Figure 13 shows a horizontal cross-section of the boiler of Figure 12 along line XIII-XIII of Figure 12;

Figure 13a shows a horizontal cross-section of another embodiment of a boiler having two secondary heat exchanger sections in series;

Figure 14 shows a horizontal cross-section of another

embodiment of a boiler having a single secondary heat exchanger section along the same line as Figure 13;

Figure 14a shows a horizontal cross-section of another embodiment of a boiler having more than one secondary heat exchanger along the same line as Figure 14;

Figure 15 shows a burner unit for use in the boilers of Figures 1 to 14, for use with gaseous fuel;

Figure 16 shows an alternative embodiment of a burner plate arrangement for the burner unit, having a set of individual burner plates;

Figure 17 shows a section of Figure 16 along the lines XVII-XVII of Figure 16;

Figure 18 shows an alternative embodiment of a burner plate arrangement for the burner unit, having a different arrangement of individual burner plates;

Figure 19 shows a section of Figure 18 along the line XIX-XIX of Figure 18;

Figure 20 shows an embodiment of a burner according to the invention;

Figure 21 shows a section on line XXI-XXI of Figure 20;

Figure 22 shows an arrangement in which V-shaped baffles are provided behind the tubes;

Figure 23 shows another arrangement in which V-shaped baffles are used with a double row of tubes;

Figure 24 shows an arrangement in which a slotted baffle plate is used.

Description of Preferred Embodiment

Figures 1, 2, 3, 4 and 5

Figure 1 shows a preferred embodiment of a central heating boiler according to the invention. The boiler comprises a heat exchanger 1 constructed from a close parallel array of heat exchanger tubes 2a and 2b which in this case are vertical and have radial fins 3 to increase their effective heating surface area, the tubes 2a and 2b being fixed at either end into respective upper and lower headers 4a and 4b, so that water may flow between the headers through the tubes 2a and 2b . The tubes 2a and 2b define parallel sides of a generally prismatic combustion chamber 6., the headers 4a and 4b defining parallel end faces thereof and one substantially planar side of the prism being defined by

the burner unit 5, so that the headers 4a and 4b define ends adjacent the side defined by the burner unit. The space thus defined forms the combustion chamber 6, combustion gases 8 passing from the combustion chamber 6 past the tubes 2a and 2b of the heat exchanger 1 through the parallel sides of the prismatic combustion chamber 6. The heat exchanger 1 is contained in a casing 7 so that the combustion gases 8 are to led to a flue 9. A casing 7 of the boiler unit is designed so that the flow of combustion gases 8 from the combustion chamber 6 over all the tubes 2a and 2b is substantially uniform.

Figure 1a is substantially similar to Figure 1, except that the outer casing 7a comprises a wrapper plate making a sliding joint or flexible expansion joint with the upper and lowers 4a and 4b, the wrapper plate defining outer surfaces of the boiler unit parallel to the tubes of the heat exchanger, the other faces being defined to the burner unit 5 (as in all embodiments of the invention) and the outer faces of the upper and lower headers 4a and 4b.

Figure 2 shows a vertical cross-section of the boiler of Figure 1, along the line II-II in Figure 1.

Figure 3 shows a horizontal cross-section of an embodiment of the boiler of Figure 1 in plane III-III of

Figure 1. In this embodiment, the headers 4a and 4b are generally rectangular in plan and the tubes 2 define three sides of a rectangular prism.

Figure 3a shows a horizontal cross-section of a different embodiment of the boiler, which is substantially identical to the boiler of Figure 3, except that a double row of tubes 2 is used.

Figures 4 and 5 show horizontal cross-sections of boilers according to alternative embodiments, in which the headers 4a and 4b are of generally rectangular plan, but the tubes 2 define five out of six sides of an irregularly hexagonal prism, and the curved side of a semi-circular prism respectively.

In the arrangement shown in Figure 1, the upper header 4a is divided along its length by a vertical plate 10, the two parts of the upper header 4a being connected to tubes 2a and 2b respectively. Water is fed into one part of the header 4a via tube 11, flows down tubes 2a to the lower header 4b, which is undivided, and thence up tubes 2b to the other part of the upper header 4a and out via tube 12. The water thus makes two passes past the combustion chamber.

Other arrangements of dividing walls in the upper and

lower headers may be adopted to achieve one pass, two passes or more than two passes past the combustion chamber, and a different distribution of water temperatures.

Figures 6, 7, 8, 9, 10, and 11

Most boiler units operate at maximum efficiency at or close to a given delivery rate of hot water. However, the heating capacity required for a central heating system may fluctuate greatly, requiring flow rates which, if supplied by a single boiler would fall far outside the boiler's range of maximum efficiency. An approach to this problem is to provide a series of boilers, the number of which in operation will vary with the demand.

Figure 6 and 7 shows a double boiler system in which boiler units 13 are accommodated side-by-side inside a single casing 14. The casing 14 is divided internally by a plate 15 so that each boiler unit 13 occupies a single cell of the casing, but delivers combustion gases 8 to a single flue 16.

Figure 8 and 9 shows a similar arrangement for stacking four boiler units 13a and 13b above and below each other as well as side-by-side. The casing 14 is internally

divided by plates 17 and 19 which divide the internal space into cells in which the boiler units 13 are located. The plates 19 also define an internal flue 18 leading to the common flue 16 for exhaust gases from the lower boiler units 13a.

Figures 10 and 11 show an alternative system in which three boiler units 13 are stacked vertically one on top of the other. In this case, internal flues 18 and 21 are provided, definined by the vertical plates 19 and 20, for conducting combustion gases from the lower tube boiler units to the common flue 16.

The boiler units 13 in Figures 8, 9, 10 and 11 are shown mounted with the tubes horizontal. As the boiler units 13 tend to be longer in the direction of the tubes, the overall shape of the boiler assembly may be varied according to the space available for the boiler by mounting the boiler unit 13 with the tubes horizontal or vertical.

Figures 12, 12a, 12b, 13, 13a and 14b

The boiler unit of Figures 1 to 5 can be very easily adapted to include a secondary heat exchanger in the form of a waste heat boiler or condensing water heater 22 in a rearward extension of the casing 14 adjacent the

face of the combustion chamber opposite the burner unit 5. As shown, the secondary heat exchanger 22 comprises a double bank of vertical parallel finned tubes 13, though there may be one, or more banks of tubes 13. The tubes 13 are connected at either end to upper and lower headers 24 and 25, water being circulated through the secondary heat exchanger 22 before being fed into the upper header 4a of the heat exchanger 1. The upper header 25 of the secondary heat exchanger 22 may be divided into two sections by a longitudinally extending plate 26, water being fed by pipe 27 into one part of the upper header 25 whence it flows through tubes 23a to the lower header 24 returning via tubes 23b to the other parts of the upper header and via pipe 28 to the heat exchanger 1.

Alternative flow patterns may be set up within the secondary heat exchanger tubes and header to achieve a different direction of flow or different distribution of water temperature . When the secondary heat exchanger comprises a condensing water heater, the exhaust gases 29 are cooled sufficiently for any water vapour created by combustion to condense. The casing 14 should accordingly be provided with a condensate outlet 30.

As shown in Figure 12, the primary and secondary heat exchanger headers 24, 25, 4a and 4b may be constructed

separately or integral with each other. Where the headers are formed integrally, flow connections may be formed between, for example, the upper secondary header 25 and the upper primary header 4a in the body of the combined header, making external interconnecting pipes unnecessary.

As shown in Figure 13, the casing 14 is sub-divided into a primary heat exchanger section 31 and a secondary heat exchanger section 32 by a vertical plate 33, a space being provided for exhaust gases 29 to flow from the combustion chamber section 31 to the secondary heat exchanger section 32 and thence to the flue 9.

As shown in Figure 13a, the secondary heat exchanger section 32 may be divided into two secondary heat exchanger sections 32a, 32b, in series. This increases the ability of the system to extract heat from the combustion gases, and accordingly increases the efficiency of the boiler. In this embodiment of the boiler, water may be circulated through the first secondary heat exchanger 22a, then through the second secondary heat exchanger 22b and thence to the main boiler. A set of vertical plates 33a and 33b act as a series of baffles to direct the combustion gases from the primary heat exchanger section 31 past the first and second secondary heat exchangers 22a and 22b to the flue

9.

An alternative embodiment of the boiler unit comprising a condensing water heater is shown in horizontal cross section in Figure 14. In this embodiment, the secondary heat exchanger zone 32 is separated from the combustion zone 31 by two vertical plates 33a and 33b with a space for combustion gases 29 to flow through. This allows for a more even distribution of flow of combustion gases in the boiler unit.

Figure 14a shows a configuration of baffles 33a, 33b, 33c which can be used to direct the exhaust gases over a first secondary heat exchanger 22a past a second secondary heat exchanger 22b to a flue 9.

Figure 12a is substantially similar to Figure 12, except that the outer casing 14a comprises a wrapper plate making a sliding joint or expansion joint with the upper and lower headers 4a and 4b as in Figure 1a. Figure 12b is a vertical section of Figure 12a along section XII-XII.

Figures 15, 16, 17, 18 and 19

The boiler units of Figure 1 to 5 may be constructed to burn either oil fuel or fuel gas. A suitable pre-mix

burner for burning fuel gas is shown in Figure 15. Fuel gas is delivered to the burner via pipe 34 and air is forced into the burner by the fan 36, the fuel gas and air being mixed in the region of an air orifice 35. The gas is delivered radially outwards through holes 37 in a gas distribution part of the pipe 34. The gas/air mixture is delivered to a burner plate 38 which defines one face of the combustion chamber, the gas being burnt in the combustion chamber on the other side of the burner plate 38. It is important to ensure that the speed of flow of the gas/air mixture through the burner plate 38 is greater than the flame speed of the gas/air mixture being burnt. If this is not the case, there is a danger that flashback will occur and an explosion may result.

Gas distribution screens 39 are disposed between the burner plate 38 and the fan 36 to assist in distributing the gas/air mixture evenly to all parts of the burner plate 38; a pressure drop results giving authority to the flow thereby preventing pressure fluctuations from the combustion process causing ocsilations of the flow with resultant noise and vibration.

The burner plate 38 must be designed to allow for thermal expansion. This is particularly easy if it is of planar or curved planar form. However, in the case of

large burner outputs, the burner plate 38 may be formed from a set of planar or curved planar burner plate sections 40, each burner plate section 40 being separately mounted and receiving gas/air mixture from a common manifold 41, as shown in Figures 16 and 17. As shown in Figure 16a, the burner plates may be of substantially bowed section, and set up with their axes parallel. As shown in Figure 16, the manifold 41 may be located at the extreme end of the burner plates, or as shown in Figures 18 and 19 in the central region.

Figures 20 and 21.

Figure 20 shows a burner unit substantially similar to the burner unit of Figure 15 but comprising a more efficient gas/air mixing system. Air is delivered by fan 36 along a duct 42 in which a plate 43 having a plurality of orifices 35 is located. The plate 43 is positioned substantially at right angles to the flow of air through the duct 42, and the orifices 35 are spaced apart in the plane at right angles to the flow of air through the duct 42. The orifices 35 are preferably of a circular section and arranged in a square pattern; however, any shape of orifice or configuration or number of orifices may be used. Fuel gas is mixed with the air in the region downstream of the orifices 35 being delivered through the holes 37 in respective gas

distribution parts of a branched pipe 44, each gas distribution part being located a small distance (compared with the dimensions of the orifices) downstream of each orifice on the axis of the respective orifice.

Each gas delivery part may have fixed gas distribution jets (or more gas distribution jets, or less) for delivering the gas in directions substantially at right angles to the flow of air in the duct 42.

Figures 22, 23 and 24

Various methods may be used to improve the flow of the combustion gases 8 over the trailing surfaces of the fins 3 of the tubes 2.

Figure 22 shows an arrangement in which longitudinally extending V-section baffles are placed parallel to and behind the tubes 2 to deflect the gases over the trailing parts of the fins 3.

Figure 23 shows a similar arrangement in which the V-shaped baffles are used in association with a double row of tubes. The orientation of the V-shaped baffles is designed to enhance the flow to the maximum extent - thus as shown in Figure 22, the orientation at corners

of the tube array may be different from the orientation along faces of the tube array. Instead of V-shaped baffles, a slotted plate baffle may be used, as shown in Figure 24. A slotted baffle plate 46 is mounted parallel to the axes of the tubes 2 and closely behind them.

The present invention has been described above purely by way of example, and modifications may be made within the spirit of the invention. The invention also consists in any individual features described or implicit herein or shown or implicit in the drawings any combination of such features or any generalisation of such features or combination.

Claims.

1. A boiler unit comprising:

a combustion chamber having heat exchanger conduits, for conducting a liquid to be heated,

a burner unit forming substantially the whole of one side of the combustion chamber.

2. The boiler unit of Claim 1, wherein the heat exchanger conduits comprise a set of tubes, the tubes communicating at their ends with respective first and second headers, said first and second headers defining sides of the combustion chamber adjacent to the burner unit side.

3. The boiler unit of Claim 1 or 2, wherein the headers are divided so that the liquid to be heated makes more than one pass.

4. The boiler unit of Claim 1, 2 or 3, wherein the heat exchanger conduits comprise a set of vertical parallel tubes.

5. The boiler unit of Claim 4, wherein in a horizontal cross-section of the boiler unit, the centres of the tubes lie on the sides of a shape, the side formed by the burner unit closing the shape.

6. The boiler unit of Claim 4, wherein there is a multiple row of tubes, and wherein in a horizontal cross-section of the boiler unit, the centres of at least one of the rows of tubes lie on the sides of a shape, the side defined by the burner unit closing the shape.

7. The boiler unit of Claim 5 or 6, wherein said shape is a rectangle.

8. The boiler unit of Claim 5 or 6, wherein said shape is a semi-circle.

9. A boiler assembly comprising a number of boiler units according to any of the preceding Claims, and a casing integrally comprising cell regions and flue regions, the cell regions housing the boiler units and communicating in parallel with the flue regions.

10. A boiler comprising a boiler unit according to any of Claims 1 to 8, wherein the outer casing of the boiler unit comprises a wrapper plate substantially parallel to the tubes of the heat exchanger and connected to the upper and lower headers of the heat exchanger.

11. A boiler assembly comprising a boiler unit according to any of of Claims 1 to 6, and further comprising a

secondary heat exchanger.

12. The boiler assembly of Claim 11, wherein the secondary heat exchanger comprises a set of tubes through which the liquid to be heated flows before flowing through the boiler unit, all of the tubes communicating at their ends with respective headers, said headers defining faces parallel to the headers of the boiler unit, the casing being sub-divided into a secondary heat exchanger zone and a boiler unit zone by a wall parallel to the heat exchanger of the boiler unit so that combustion gases flow from the boiler unit zone to the secondary heat exchanger zone.

13. The boiler assembly of Claim 11 or 12, wherein the secondary heat exchanger is a condensing heat exchanger.

14. The boiler assembly of any of Claims 11 to 13, wherein the secondary heat exchanger comprises a first secondary heat exchanger and a second secondary heat exchanger in series, the exhaust gases flowing from the combustion chamber past the first secondary heat exchanger and then past the second secondary heat exchanger.

15. The boiler unit of any of Claims 1 to 8, wherein the burner unit is a gas burner having a planar burner

surface defining one side of the combustion chamber.

16. The boiler unit of Claim 15, wherein the burner unit comprises a set of burner subunits connected to a common fuel and air supply.

17. A fuel gas/air mixing device, for use with a fuel gas burner, comprising:

means for delivering a flow of air through a number of orifices,

respective fuel gas delivering means downstream of each orifice for delivering fuel gas into the air flow from each orifice,

a mixing duct wherein the fuel gas and air mix before being delivered to a combustion zone of the burner.

18. The fuel gas/air mixing device of Claim 17, wherein the orifices through which the air is delivered are spaced apart from each other in a plane substantially at right angles to the flow of air.

19. The fuel gas/air mixing device of Claim 17 or 18, wherein the means for delivering a flow of air delivers the air through a duct, and the orifices are defined in

a plate located in the duct substantially at right angles to the flow of air through the duct.

20. The fuel gas/air mixing device of any of Claims 17 to 19, wherein each fuel gas delivery means comprises a delivery part having a plurality of holes in it, communicating with a fuel gas supply, for delivering a jet of fuel gas into the air flow in respective directions substantially at right angles to the direction of flow of the air.

21. The fuel gas/air mixing system of any of Claims 17 to 20, wherein the distance between each orifice and its respective fuel gas delivery part is small compared with the dimensions of the orifice.

22. The fuel gas/air mixing device of any of Claims 17 to 21, wherein the orifices are circular.

23. The fuel gas/air mixing device of any of Claims 17 to 22, wherein the orifices are arranged in a substantially square pattern.

24. A boiler unit comprising:

a combustion chamber having heat exchanger elements, for conducting a liquid to be heated,

a burner forming substantially the whole of one side of the combustion chamber, the combustion chamber being defined entirely by the heat exchanger elements and the burner unit.

25. The boiler unit of Claim 24, wherein combustion gases from the combustion chamber leave the combustion chamber only through sides of the combustion chamber defined by the heat exchanger elements, the combustion gases flowing around the heat exchanger elements.

26. A boiler unit substantially as herein described with reference to and as shown in the accompanying drawings.

27. A boiler assembly substantially as herein described with reference to and as shown in the accompanying drawings.

28. A fuel gas/air mixing device substantially as herein described with reference to and as shown in the accompanying drawings.

Published 1991 at The Patent Office, Concept House, Cardiff Road, Newport, Gwent NP9 1RH. Further copies may be obtained from Sales Branch, Unit 6, Nine Mile Point, Cwmfelinfach, Cross Keys, Newport, NP1 7HZ. Printed by Multiplex techniques ltd, St Mary Cray, Kent.

PUB-NO: GB002244799A
DOCUMENT-IDENTIFIER: GB 2244799 A
TITLE: Boiler unit
PUBN-DATE: December 11, 1991

INVENTOR-INFORMATION:

NAME	COUNTRY
WELLS, JACK DONALD	N/A

ASSIGNEE-INFORMATION:

NAME	COUNTRY
WELMARK LIMITED	GB

APPL-NO: GB09012045
APPL-DATE: May 30, 1990

PRIORITY-DATA: GB09012045A (May 30, 1990)

INT-CL (IPC): F23D014/02 , F24H001/44

EUR-CL (EPC): F24H001/40 , F24H008/00 , F23D014/62

US-CL-CURRENT: 431/354

ABSTRACT:

CHG DATE=19990617 STATUS=O> In order to provide a boiler unit which is simple to make in a variety of sizes, and which is economical of space in single or multiple boiler assemblies, and which can be adapted to

include a condensing water heater, the boiler unit comprises a combustion chamber 6, with heat exchange conduits 2 for conducting the liquid to be heated, and headers at the opposite ends of the conduits defining all but one side of the combustion chamber, the burner unit 5 forming substantially the whole of the remaining side. Fuel and air are mixed upstream of a burner plate by introducing fuel through radial openings in one or more fuel pipes into a stream of air which has just passed through orifices corresponding to the number of fuel pipes. □